

# DESIGN AND FABRICATION OF AUTOMATIC FLOOR CLEANER

*A thesis Submitted in partial fulfilment of the requirements for  
the award of the degree of*

Bachelor of Technology  
In  
Mechanical Engineering  
By

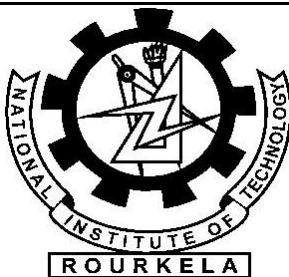
**Swarup Raj Jena  
(111ME0299)**

Under The Guidance of

**Prof. K. P. Maity**



**Department of Mechanical Engineering  
National Institute of Technology Rourkela  
Orissa -769008, India  
2014-15**



## National Institute of Technology Rourkela

### CERTIFICATE

This is to certify that the thesis entitled — “**Design and fabrication of Automatic Floor Cleaner**” submitted to the National Institute of Technology, Rourkela (Deemed University) by **Swarup Raj Jena, Roll No. 111ME0299** for the award of the Degree of **Bachelor in Technology** in Mechanical Engineering is a record of research work carried out by him under my supervision and guidance. The results presented in this thesis has not been, to the best of my knowledge, submitted to any other University or Institute for the award of any degree or diploma. The thesis, in my opinion, has reached the standards fulfilling the requirement for the award of the degree of Master of technology in accordance with regulations of the Institute.

Place: Rourkela

Dr. K. P. Maity

Date

Professor

Department of Mechanical Engineering

National Institute of technology,

Rourkela- 769008

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## *Acknowledgement*

I express my deep sense of gratitude and indebtedness to my thesis supervisor Dr. K. P. Maity, Professor of Mechanical Engineering for providing precious guidance, inspiring discussions and constant supervision throughout the course of this work. His timely help, constructive criticism, and conscientious efforts made it possible to present the work contained in this thesis.

I express my sincere thanks to Prof. Suraj Kumar Behera and Mr. Rajaranjan Senapati, Btech student for their support during the project work. I am also thankful to all the staff members of the department of Mechanical Engineering and to all my well-wishers for their inspiration and help. I am also thankful to my classmates for their help during my project work.

I feel pleased and privileged to fulfil my parent's ambition and I am greatly indebted to them for bearing the inconvenience during my B Tech. course.

Swarup Raj Jena  
Roll No:111ME0299

## ***CHAPTER -1***

### **ABSTRACT**

Automatic floor cleaner is a system that enables cleaning of the floor by the help of highly stabilized and rapidly functionalized electronic and mechanical control system. Current project work targets to use automatic floor cleaner for large floor in house-hold purposes and office floors. The cleaning purpose is specifically carried out by continuous relative motion between a scrubber and the floor surface. During the cleaning and moving operation of vehicle a propulsion mechanism such as driven wheels and guide wheels for the dry tracking on the floor surface to be cleaned, suction of water is carried out by vacuum pump, scrubbing action is done by the scrubber directing water towards rear end. Preferably, a sweeper mechanism is mounted on the body forwarded by propulsion mechanism and operated with such control system for advance sweeping of a debris-laden floor surface. A PID controller is used to govern the motion of system which takes the input from sensor circuit and feeds it back to microcontroller which gives rise to the simulation of wheel in a synchronized manner. The new automatic floor cleaner will save huge cost of labor in future. The basic advantage of this product is that it will be cost effective and no human control is needed. Once put in on mode it will clean the whole room without any omission of surface.

## ***CHAPTER-2***

### **INTRODUCTION**

#### **2.1 CLEANING:**

Cleaning is the essential need of the current generation. Basically in household floors the floor has to be cleaned regularly. Different techniques are used to clean the different types of surfaces. The reasons for floor cleaning are

- Injuries due to slips on the floors are cause of accidental injuries or death. Bad practice in floor cleaning is a major cause of accidents.
- To beautify the floor.
- Debris and obstructions are to be removed.
- Allergens and dusts are to be removed.
- Surface wear to be avoided.
- To make the environment sanitary (kitchens).
- Traction should be maintained at optimum level, so that no slip will occur.

Floor cleaning is achieved by different technique which might be of different kinds. Different types of floor need different type of treatment. The floor should be totally dry after the cleaning process. Otherwise it may result in hazard. On some floors sawdust is used to absorb all kinds of liquids. This ensures that there will no need of preventing them from spill of. The sawdust has to be swept and replaced every day. This process is still used in butchers but it was common in bars in the past. In some places tea leaves are also used to collect dirt from carpets and also for odor removing purposes. Different types of floor cleaning machines are available today such as floor buffers, automatic floor scrubbers and extractors that can clean almost all types of hard floors or carpeted flooring surfaces in very less time than it would have taken using traditional cleaning methods. Again the cleaning would be different for different floorings.

#### **2.1.1 WOODEN FLOOR:**

Wooden flooring is treated differently depending on which type of coating it has, whether waxed or oiled, or whether it has a polyurethane coating. The very important thing in case of this

type of floor is which type of coating it is having and find out the proper way of cleaning it. Simple cleaning instructions followed are

1. The floor should be cleared of all the furniture those are easy to move.
2. All loose debris particles are to be swept or vacuum cleaned.
3. The floor is mopped going along grains. If the floors are polyurethane, the mop has to be dipped with water and a few drops of dishwashing liquid. The mop should be ringed out thoroughly before it is used on the floor.
4. The floor is to be buffed using a soft fabric to remove soapy dirt. The softer the cloth, the better it works because they have good absorbent capacity.

### **2.1.2 TILE OR STONE FLOORS:**

Modern houses are equipped with tiles, marble flooring that can be cleaned easily. Few specific ways are:

1. Debris particles are to be removed using vacuum cleaner or else broom.
2. Floor cleaning solution should be used for appropriate floors. If it is stone surface, it should be cleaned using solutions for stones only. For ceramic floors acidic tile cleaning agent is to be used.
3. A mop or scrubber is used to scrub and clean the floor.

## **2.2 SCRUBBER**

Basically the Indian floors are cleaned by rubbing the floor with a hard cloth or plastic like material called scrubber or mop. Hence design of scrubber is an important task while cleaning Indian floors. The motion of scrubber on the surface may be rotatory or harmonic depending upon the type of material used or surface to be cleaned. Normally hard material like heavy cloths are used for making the scrubber. The basic purpose of the scrubber is to clean the surface completely and also soak the water or liquid used for cleaning the surface. In our case we have used a scrubber that is made up of a cloth wound over a metallic bar (cylindrical rod). The additional purpose of the scrubber is to make proper flow of dirt water towards the direction needed. In some cases a single spot is to be scrubbed more than once. For this purpose harmonic motion is used which enable better removal of debris. But in our case the purpose is to clean household flooring so relative rotation of scrubber is made to achieve required purpose.

## **2.3AUTOMATION:**

It is the process of using different components to make the whole machinery process operate automatically. We may use micro-controller, image sensing technique for achieving desired motion. Especially when different types of motions are involved the process become very much complicated and need different algorithm for optimum movement of the system. Again when different power sources are used and they have to be operated at different time micro-controller is essential. In our case the purpose of the micro-controller is to make all the systems work in proper sequence and move according to the image sensed. Image sensing is basically achieved by ultrasonic sensors. These type of sensors work according to the passive type of sensory circuit. This system sends ultrasonic range wave and the wave reflects after encountering any obstacle. This retraced wave is sensed by the sensory circuit which there by calculates the distance of the obstacle. The data achieved from this process is processed for the future movement of the machine.



## ***CHAPTER-3***

### **AIM OF PRESENT WORK :**

Present work is aimed at working of an automated motion controlled machine that could clean the floor of normal Indian house-hold. Once the machine is put in ON mode it will move all over the surface without omitting any bit of floor space. Again the machine should avoid the obstacles on its path. Proper cleaning is achieved by motion of the scrubber which is relatively rotational in manner. The cleaning process is carried out by making the floor wet and scrubbing it and again making the floor dry. The floor should be dry after the process is complete because wet floor leads to different sort of problems as discussed above. For this purpose vacuum pumps are to be used. The cleaning also meet challenges like which type of debris it will meet. So dry cleaning arrangements are installed. This leads to proper cleaning when heavier particles are there as debris particle. Thus leading to proper cleaning of the surface. There may be oily surfaces in some cases. To counter act this situation necessary disinfectants are to be used. 4 wheel drive mechanism should be used for proper control of the machine. To control all the motors and vacuum pumps basically micro controller of Aurdino type is used. For completing the motion all over the surface spiral mechanism and particle swarm optimization method is being utilized. Image sensing technique for avoiding obstacles are to be used. Optimization methods are used for increasing efficiency of movement algorithm. It ensures no repeatability of the motion over a certain space. Basically we are to design a portable machine that could move automatically all over the floor surface avoiding obstacles and cleaning the floor.

## ***CHAPTER-4***

### **LITERATURE REVIEW :**

Traditionally floor is cleaned by hand using different handmade instruments. Initially it was being washed by different reed brushes. According to Egyptian houses were built of sun-dried mud bricks at times white-washed and the floors were stamped earth. The floor of the outdoor kitchen too was simply the ground baked stone hard by the sun. Unless it was raining, which happened only rarely, these floors were easy to keep clean by sweeping. Like most ancient Egyptian tools, these brushes did not have long handles which would have rendered their use less irksome, and required bending low when employing them.

For the ease of human beings different designs of brushes are evolved. Again during the age of monarchs carpets of different designs are utilized to cover the floor to keep it clean. As the time passed new scientific era begins a lot of new methods are used to clean the floor. The first among those was the reciprocating action of brush actuated by muscular force. The brush design is changed time to time depending upon the floor structure and ease of washing personnel. As the electricity came into role vacuum cleaner are invented to clean a dry surface. Moving forward different floor cleaning machines are being invented to clean the floor with less application of muscular power. Then came the concept of mobile robot..Mobile robots have the capability to move around in their environment and are not fixed to one physical location. By contrast, industrial robots are usually more-or-less stationary, consisting of a jointed arm (multi-linked manipulator) and gripper assembly (or end effector), attached to a fixed surface.

For the help of mankind the first floor cleaner was manufactured during 1980s. In those equipment the aim was to wash the floor with less power utilization. There sweeping mechanism of mop is actuated by a timing motor which was controlled by the dc circuit. Here water is sprinkled on the mop and hence the wet mop is used to clean the debris from the floor. But the problem here was it can't use any chemical solvent or disinfectant. Again for soaking purpose only hot air is used. Again for moving the machine a worker has to be engaged. To overcome these conflicts current study was done to enable the cleaner move automatically throughout any kind of room. The moping mechanism is also modified to lessen the cost. In current study the mop is continuously revolving about a axis perpendicular to the motion of the cleaner which also helps in directing water on the floor backward. Instead of using a wet mop a sprinkle mechanism is used to make the floor wet which is scrubbed by the mop. A vacuum cleaner was used to soak dirty water from the floor surface and side by side cleaning the surface. For automatic motion of the cleaner mobile robotics is used.

Mobile robots are a major focus of current research and almost every major university has one or more labs that focus on mobile robot research. Mobile robots are also found in industrial, military and security settings. Domestic robots are consumer products, including entertainment robots and those that perform certain household tasks such as vacuuming or gardening. From then on more sophisticated robot is designed for household equipment for automating the tasks including washing machine, micro woven. After that only the revolution of mobile robotics came to household usages.

The problem with current automatic floor cleaning machines are they are only used in households for only dry and wet cleaning but not as infection remover. So it is only used in households and not in hospitals or small areas in public. The automatic floor mops like hydrobot are bulky and they also require large power and are used for commercial purpose. But we think this (Our cleaner) will solve all in one go... We will basically focus on a smart and smaller and good designed robot which can be used in many sectors like healthcare and educational areas (which are of course small areas) and also for household use. So it will be both for terminal cleaning like medicals and indoor floor cleaning. In future we will focus on indoor air cleaning service as an additional feature to this machine.

#### **4.1 Body:**

A robot to move automatically should know a few data about its co-ordinate and how to reach at various destinations and/or way points throughout the path. Knowledge of the instant location, is being determined by a number of ways, using a number of sensors such as motor encoders, vision, reacts to alerts, works lifts and tells the war room when an occurrence emerges. Other independently guided robots incorporate the SpecIMinder and the Tug conveyance robots for healing center labs, however the recent really has individuals primed and ready to drive the robot remotely when its independence fizzles. In 2013, development in automation controlled by plants was accomplished by craftsman Elizabeth Demaray and engineer Dr. Qingze amid the IndaPlant Project, and demonstration of trans-species giving.[6] They effectively made a part-robot, part-plant substance Stereopsis, lasers and global positioning systems. Position determining systems normally uses triangulation. Relative positioning is used to strictly determine the co-ordinate of location and orientation of the machine component. By accessing data from which it can plan a path to its next destination or waypoint. It also accesses sensor information that are time recognized and area recognized. For instance, it can know the exact timing and positioning of radiation levels when it surpasses reasonable level. Such robots are frequently piece of the remote venture system, linked with other detecting and controlling frameworks in the building. For example, the PatrolBot security robot

#### **4.2 Indoor Navigation**

For a robot to be explored indoor ought to think about its area and how it is going to move in not so distant future. Such route started with wire-direction in the 1970s and advanced in the mid 2000s to reference point based triangulation. Current business robots self-sufficiently explore in view of detecting characteristic highlights. The main business robots to accomplish this were

Pyxus' HelpMate healing center robot and the CyberMotion watch robot, both planned by mechanical autonomy pioneers in the 1980s [3]. These robots initially utilized physically made CAD floor arrangements, sonar detecting and divider after varieties to explore structures. The cutting edge, for example, MobileRobots' PatrolBot and self-sufficient wheelchair both presented in 2004, can make their own particular laser-based maps of a building and to explore open territories and in addition passages. Their control framework changes its way on the fly if something obstructs the way.

At to begin with, self-sufficient route was in light of planar sensors, for example, laser extent discoverers, that can just sense at one level. So robot depend on the data of one specific sensor and arrangement the development as indicated by it. The most exceptional frameworks (made by IROBOT and SCOOBA) now utilize data from different sorts of sensors. Frameworks, for example, smoothness and versatility can depend on distinctive sensors in diverse territories, contingent on which gives the most solid information at the time, and can re-delineate building self-governingly. [3]

Indoor route robots are not used to move into unpleasant territories like stairs yet its portability is done on much smoother surfaces like floors and glasses. For harsh surfaces it will be much hard to do the undertaking.

As these indoor systems keep on developping, vacuuming robots with vapor degreasing will pick up the capacity to clean a particular client determined room or an entire floor and expel strain from it. Security robots are improved for entrance and way out utilization safely and dependably. These advances likewise bring accompanying assurances: robots' inward maps normally allow "taboo regions" to be characterized to keep robots from self-rulingly entering certain districts.

Flow study was done to outline and create a floor cleaning hardware which has the capacity clean every last piece of a building naturally utilizing an arbitrary calculation which is taking

into account framework guide look.

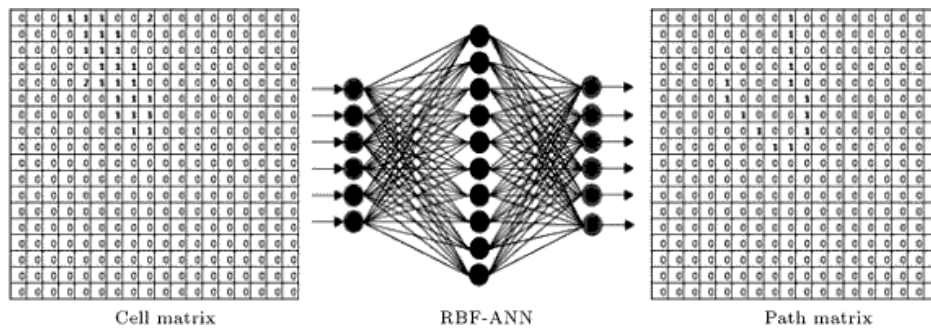


Figure1 Path matrix

In this matrix based hunt the robot will be kept amidst the room some place where it will first take after the line of the wall. When robot is first kept some place it will first focus the position and the separation and the edge of the robot from the divider or long hindrance it is going to take after. Here PID controller will be utilized to recognize the way and anticipate the movement of the robot.. The separation will be measured by IR sensor...For the separation estimation we can utilize both ultrasound cleaner and IR sensors. The separation will be secured by the assistance of connected winding ways and broadness first calculation.

### 4.3 Modelling the spiral path

The spiral path is the initial phase of coverage path planning. Therefore, at the beginning of the spiral path ,the robot is at the origin of the frame. An imaginary X axis and Y axis is drawn which meet on the initial position of robot. The spiral is either clockwise with increasing radius and decreasing theta or the spiral is anti-clockwise with increasing radius with increasing theta.

#### Straight path following:-

The virtual divider (significance the secured locale) way is characterized as a way that is adjusted to the virtual divider limit. This virtual divider way is demonstrated utilizing a quantic Bezier bend. This way era procedure contains four stages as indicated inspecting divider focuses testing way focuses sifting way

Focuses improving way utilizing the molecule swarm streamlining calculation. However at first whole way is not made overall but rather it is dead set in every venture of the advancement... We

exactly keep up seven bend segments in transit. Here, the inspected divider and way focuses are put away in particular stacks. We spare memory by expelling from the stack, likewise on the web, the pointless focuses which were utilized for creating past bend segments.

In the first process, the secured cells at the outskirts in the middle of secured and unexplored districts are tested as indicated in above figure. The focus position of every examined cell characterizes the inspected divider point. This examining methodology takes after the right-hand principle, where the secured district lies on the right half of the moving course of the example point while the unexplored locale is on the left side.

The principal point to test is given by the coarse-to-fine compelled opposite separation change (CFCIDT). Inspecting finishes when a certain point is examined twice, consequently importance circle conclusion, or when each phone around the last tested point transforms into secured or deterrent sort amid scope.

In cleaning activity when robot first performs divider after and afterward discovered a snag in an area it will make a U-turn or side movements characterized by connecting of two roundabout bends. By this two sort of systems floor leeway excess can be diminished. Be that as it may, the side-movement will be utilized as a part of limited regions for unimportant getaway of the robot. Once nature is situated up it will be directed to arranging of the cleaning. The arranging will be done by range of robot and the sweep of turn it is going to take. There must be an unmistakable way partition between these two spans.

Movement arranging (otherwise called the "route issue" or the "piano mover's issue") is a term utilized as a part of mechanical autonomy for the procedure of separating a sought development assignment into discrete movements that fulfill development limitations and potentially advance some part of the development.

Case in point, think about exploring as a versatile robot inside a building to an inaccessible waypoint. It ought to execute this assignment while dodging dividers and not tumbling down stairs. A movement arranging calculation would take a depiction of these undertakings as

information, and produce the velocity and turning summons sent to the robot's wheels. Movement arranging calculations may address robots with a bigger number of joints (e.g., modern controllers), more unpredictable errands (e.g. control of articles), diverse requirements (e.g., an auto that can just commute forward), and vulnerability (e.g. flawed models of nature or robot).

Movement arranging has a few apply autonomy applications, for example, self-rule, robotization, and robot plan in CAD programming, and also applications in different fields, for example, invigorating advanced characters, feature diversion computerized reasoning, building outline, mechanical surgery, and the investigation of natural particles. In every district of the house diverse areas are shaped where above said calculation will be directed. For a division having various no of deterrents we can frame autonomous no of parts which don't cover much. Yet, for a huge passage there will be numerous parts having greatest length  $L$  which will cover most. This is called sectorial based structure. Lattice construct methodologies overlay a matrix with respect to setup space, and expect every arrangement is related to a network point. At every matrix point, the robot is permitted to move to adjoining lattice focuses the length of the line between them is totally contained inside  $C_{free}$  (this is tried with crash location). This discretizes the arrangement of activities, and inquiry calculations are utilized to discover a way from the begin to the objective.

These methodologies oblige setting a framework determination. Hunt is speedier with coarser frameworks, yet the calculation will neglect to discover ways through tight partitions of  $C_{free}$ . Moreover, the quantity of focuses on the lattice develops exponentially in the design space measurement, which make them improper for high-dimensional issues.

Conventional network based methodologies produce ways whose heading changes are compelled to products of a given base point, regularly bringing about imperfect ways. Any-point way arranging methodologies find shorter ways by proliferating data along network edges (to pursuit quick) without obliging their ways to lattice edges (to discover short ways).



Network based methodologies frequently need to pursue over and over, for instance, when the learning of the robot about the setup space changes or the design space itself changes amid way taking after. Incremental heuristic hunt algorithms re-arranges quick by utilizing background with the past comparable way arranging issues to accelerate their quest for the present one.

These methodologies are like framework based inquiry methodologies aside from that they produce a clearing covering completely the design space rather than a matrix. The clearing is disintegrated into two sub-paving  $X^-, X^+$  made with boxes such that  $X^- \subset C_{free} \subset X^+$ . Portraying  $C_{free}$ [10] adds up to take care of a set reversal issue. Interim examination could along these lines be utilized when  $C_{free}$  can't be portrayed by straight imbalances so as to have an ensured nook.

The robot is subsequently permitted to move openly in  $X^-$ , and can't go outside  $X^+$ . To both sub-paving, a neighbor chart is assembled and ways can be discovered utilizing calculations, for example, Dijkstra. At the point when a way is achievable in  $X^-$ , it is likewise doable in  $C_{free}$ . At the point when no way exists in  $X^+$  from one beginning setup to the objective, we have the assurance that no attainable way exists in  $C_{free}$ . With respect to the lattice based methodology, the interim methodology is improper for high-dimensional issues, because of the way that the quantity of boxes to be created becomes exponentially regarding the measurement of arrangement.

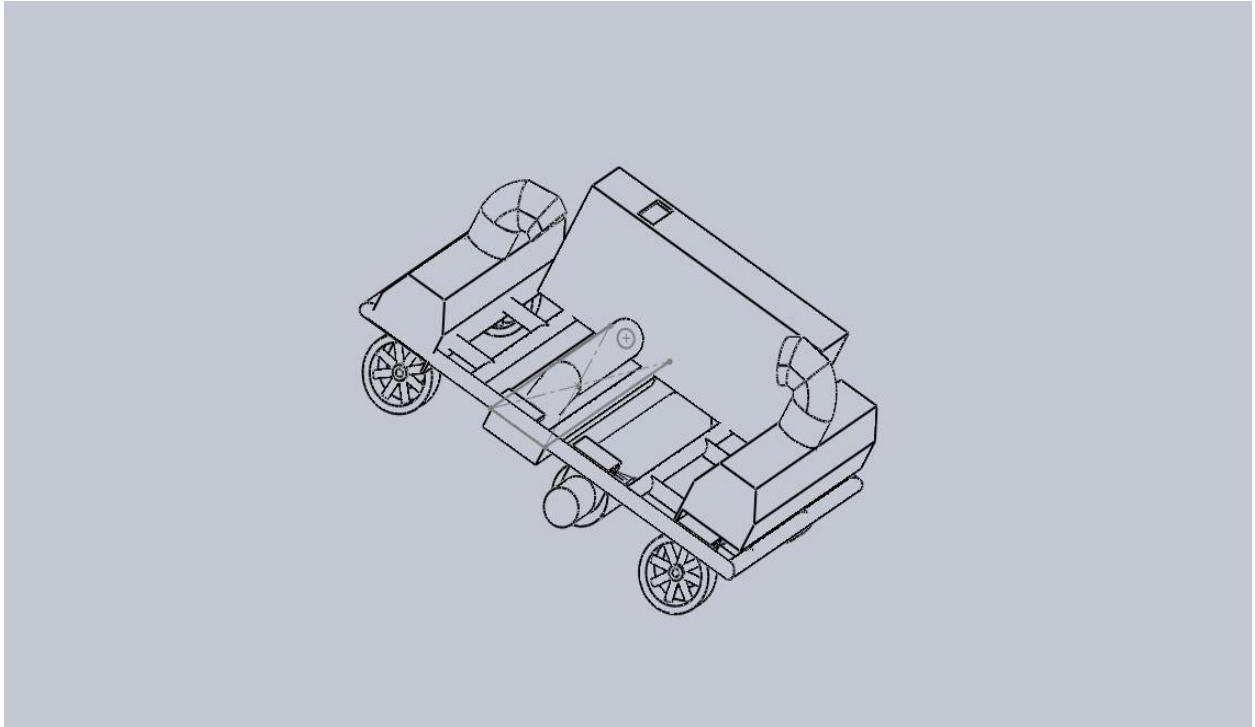
## **CHAPTER-5**

### **DESIGN OF PRESENT WORK :**

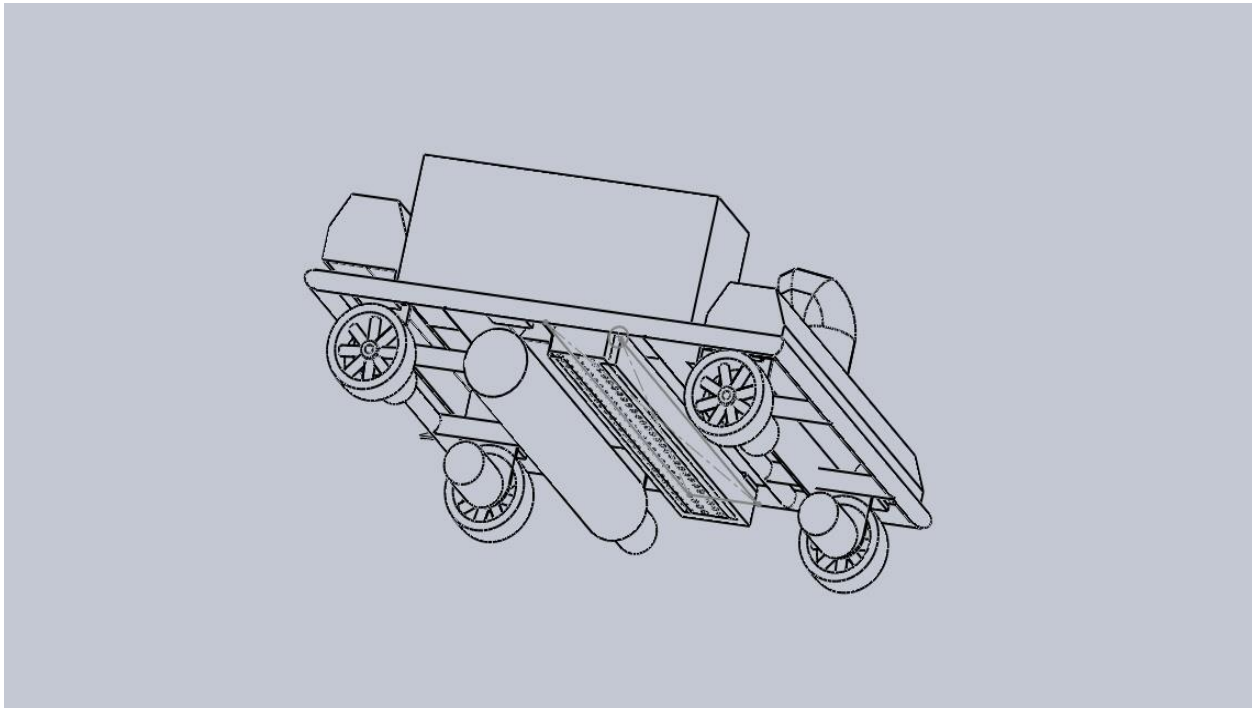
The present work is aimed at designing a compact floor cleaner that can be useful for house-hold purpose. The complete process of the machine starts from the front vacuum pump. It is used to suck dry debris from the floor. This is very much useful for the purpose of pre-cleaning the surfaces having heavier dirt particles. The debris thus sucked has to be stored so that it could be removed later. This is achieved by using a 12v vacuum pump with a debris chamber attached to it. The next aim is to make the surface wet which is carried out by sprinkling water on the floor. The aim is achieved by using a motor and a sprinkler system. This system has a shower like outlet and a chamber whose outlet is controlled by a dc motor pump. To clean the surface scrubber has to move or scrub over the floor. The dirt should be completely removed and the debris laden water will flow towards the rear of the bot. the scrubber is fixed to the chassis using clamps. The construction of the scrubber includes fixing one side to the motor and the other to the ball bearing. The bearing is clamped to the chassis. At the rear of the system a vacuum mechanism is used to suck the debris laden dirty water. This is also the same type of pump and the chamber. Hence the total system can be sub-divided into different parts, such as:

1. Chassis
2. Vacuum pumps
3. Sprinkler system
4. Scrubber
5. Motor driver
6. Wheels
7. Control system

The complete system is operated automatically throughout the floor of any kind of room.



*Figure2 Isometric view of AFC*



*Figure3 Isometric view of AFC*

## 5.1 CHASSIS:

It is the back bone of the system. All the systems and parts are attached to it. The solidity of the system is greatly affected by the chassis. It is a square of side 30cm.

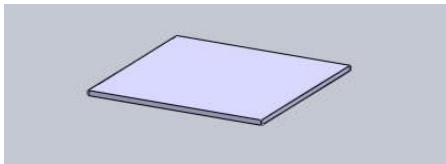


Figure4 Chasis

## 5.2 VACUUM SYSTEM:

2 number of vacuum pumps are used for 2 different purposes. Front one for collection of dry debris and the rear one for sucking of dust mixed with water. The flow rate of the pump is 12-15 LPM, vacuum range 0-16" Hg, pressure range 0-32 psi. Input parameters are voltage 12 Vdc, power 12w. Motor construction is iron core oil bearing type. Diaphragm material is EPDM.

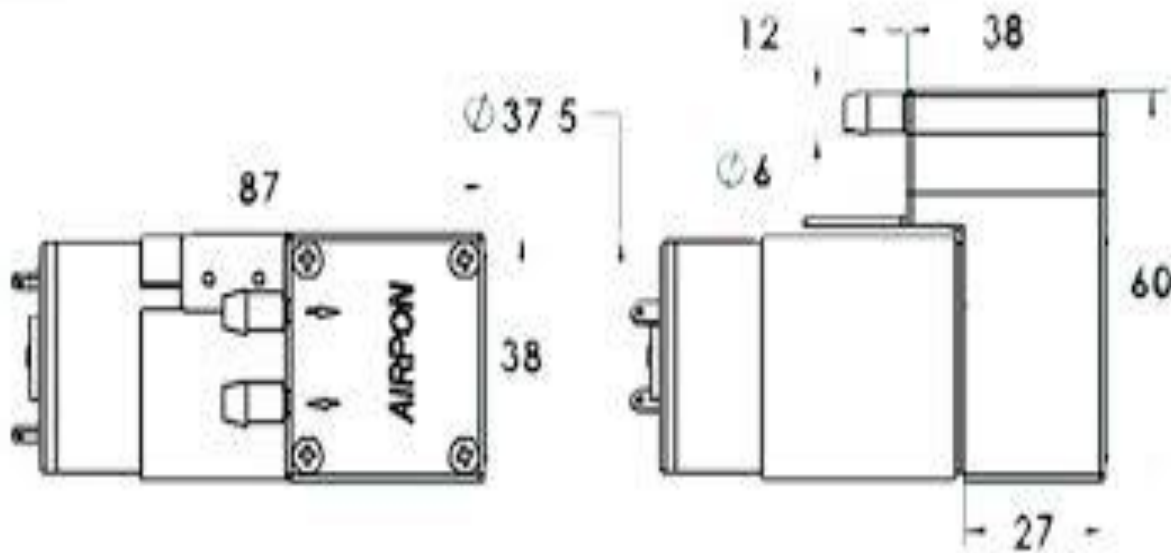


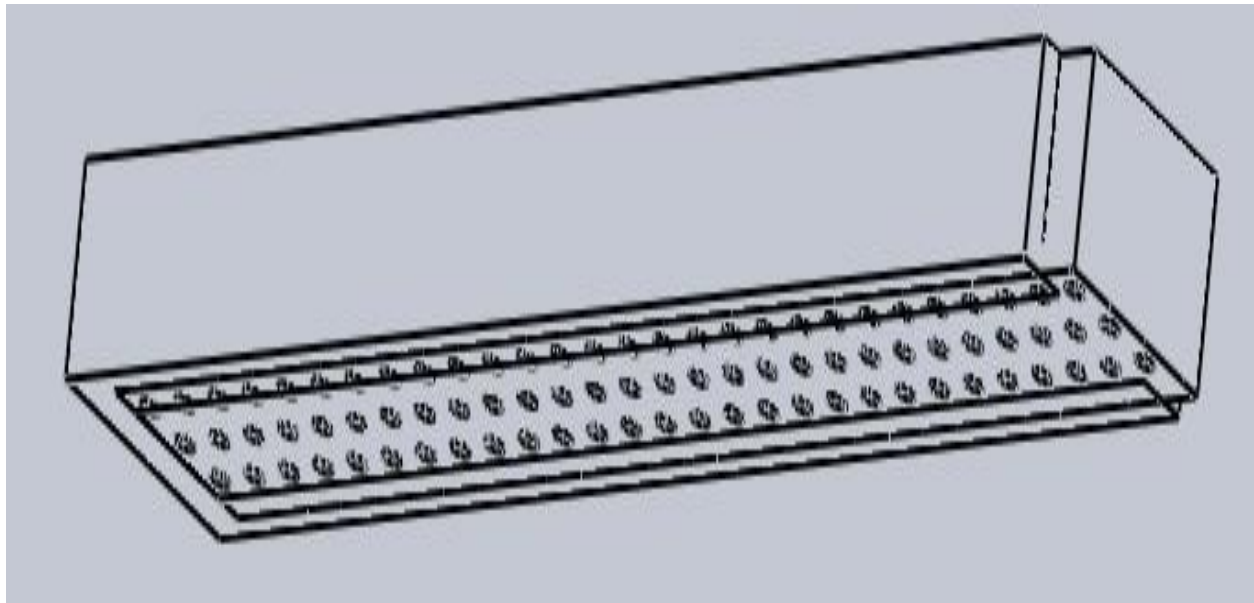
Figure5 Vacuum pump

The inlet port is connected via 5mm dia pipe to the front side. The pressure is equally distributed across the width of the machine in the front side. This is achieved by giving openings at equal intervals at the front. The outlet side is connected to the debris collecting chamber which has the

size of  $5 \times 5 \times 5 \text{ cm}^3$ . Again on the rear case same procedure is applied. But the difference here is to collect water mixed debris which needs more space for storage.

### 5.3 SPRINKLER SYSTEM:

The next work of the machine is to make the surface wet. To achieve this we have designed a sprinkling mechanism. Water is stored in a chamber that has a opening controlled by a motor. By putting this motor to ON position water or cleaning liquid starts flowing from the chamber. It is connected to a shower type arrangement via connecting pipe. the sprinkler system has a number of holes arranged sequentially which can be modified manually. This arrangement ensures equal wetness across the width. The challenge here is not to put too much liquid over the surface which may lead to wet floor after the cleaning is complete. To overcome this the motor is automated with the control system. This is programmed such a way to put required amount of liquid according to the relative stay of the machine.



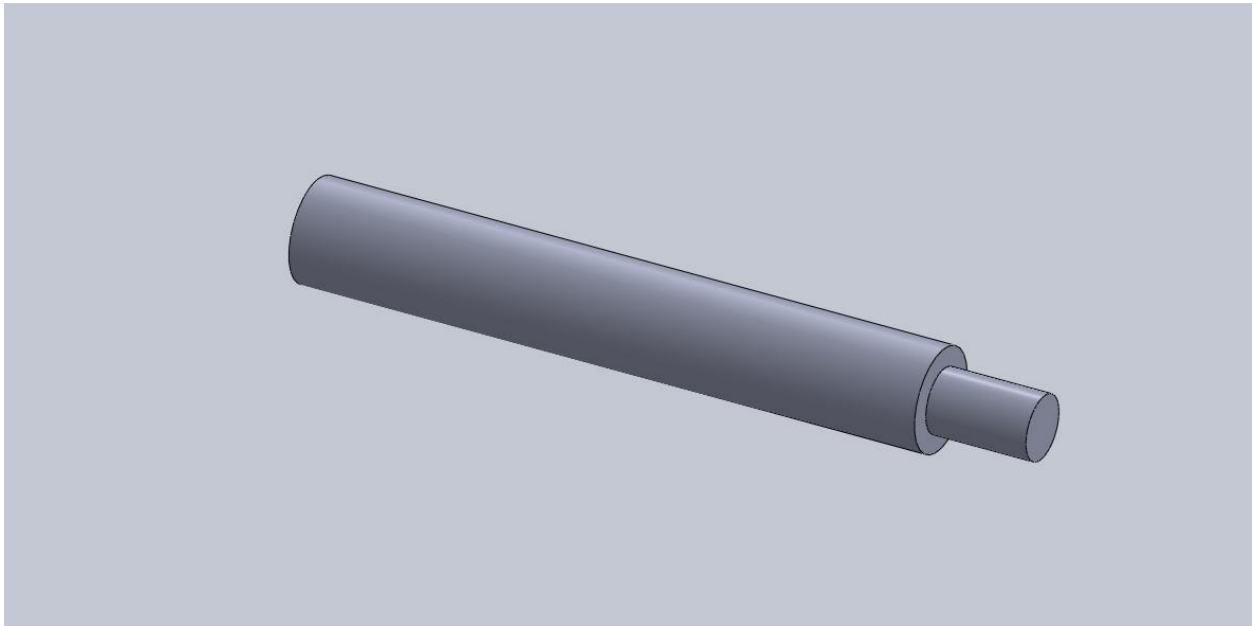
*Figure6 Sprinkle system*

The length of the system is equal to the width of the machine which is 30cm. Thus it covers the whole area. Its width is 5cm. which is optimum for required liquid flow.

## 5.4 SCRUBBING MECHANISM:

As discussed earlier scrubbing of surface is necessary for proper cleaning. For different type of floors different types of scrubbers are to be used. For stone flooring soft cloths, for cement floors hard plastics are used. In our case the scrubber is given a rotational motion to scrub the surface. The rotational motion is achieved by a 12v DC motor having 600rpm. The scrubber is as shown in fig5. One side of the scrubber is fixed with the dc motor which again clamped to the chassis by C-clamp and screw. The other part of the scrubber is connected to a ball bearing which is again clamped to the chassis via C-clamp. The connection of bearing is done by a hub. The hub is a metallic object of cylindrical shape. On one side of the hub a hole is made and the scrubber is fixed. The bearing is fitted by transition fit to the ball bearing. Transition fit is the type of fit when the diameter of the shaft and the hole are same and hence the shaft is fixed by applying continuous force. The scrubbing process has 2 advantages.

1. It ensures the surface to be proper clean.
2. It makes the flow of water towards the rear side where vacuum pump is fixed.



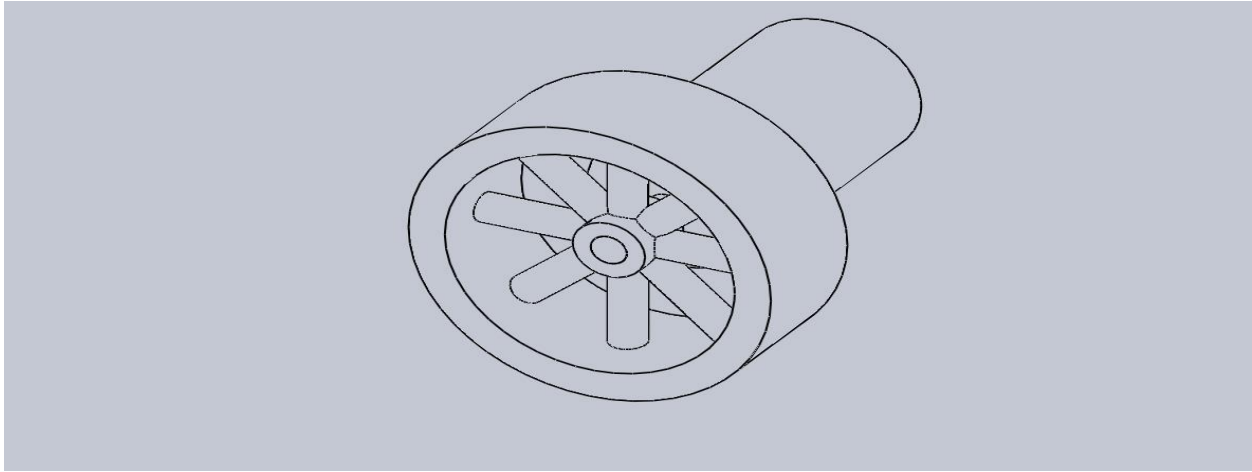
*Figure7 Scrubber system*

## 5.5 MOTOR-WHEEL SYSTEM:

The complete product is a four wheel drive automation process. 4 wheels are independently connected to 4 different 12v DC motors. The purpose of the wheels are

1. To give the bot proper motion.

2. Provide traction in all sort of surfaces.
3. Make the movement easier in all direction.
4. Not to slip of from its path.



*Figure 8 Motor-Wheel system*

The axis of motor is bolted to the axis of the wheel. The motor-wheel arrangement is fixed to the chassis using L-clamp and screw. The movement of the system can be achieved by giving power to required motor and/or making devoid of power. For example if we need to make the machine give a turn towards right the front right wheel is stopped or slowed down. Again for left turn left front wheel will be slowed. Rear wheels are always in operation to pull the system. The diameter of the wheel is 7.5cm. Proper amount of rib for traction and movement on wet floor surface.

## **5.6 CONTROL SYSTEM:**

The purpose of the control system is to give an automatic motion to the machine. Apart from that it also makes all the parts to operate in sequence and for correct interval. For example while turning it should ensure less flow of liquid through the sprinkler system. Again it has to trace all the parts of a room. In other words no part of the floor should remain untouched. Spiral motion algorithm is used for this purpose which gives 90% accuracy. For avoiding obstacles image sensing technique is used. Sensors are used on 3 sides of the machine: front, left and right. If the front sensor senses any obstacles the next task is to sense from right sensor. If this sensor doesn't show any obstacle, the machine will move towards right. But if right sensor hits any obstacle, the motion will be towards left according to the sensing data found from the left sensor.

If all the sensors sense obstacles, the machine moves back and again continues its spiral movement. Particle swarm optimization is also used to optimize the motion. If only spiral motion is used it may move over a surface a number of times. To decrease the number of repetition this algorithm is used which in other hand increases efficiency. For the automation purpose Arduino is used.

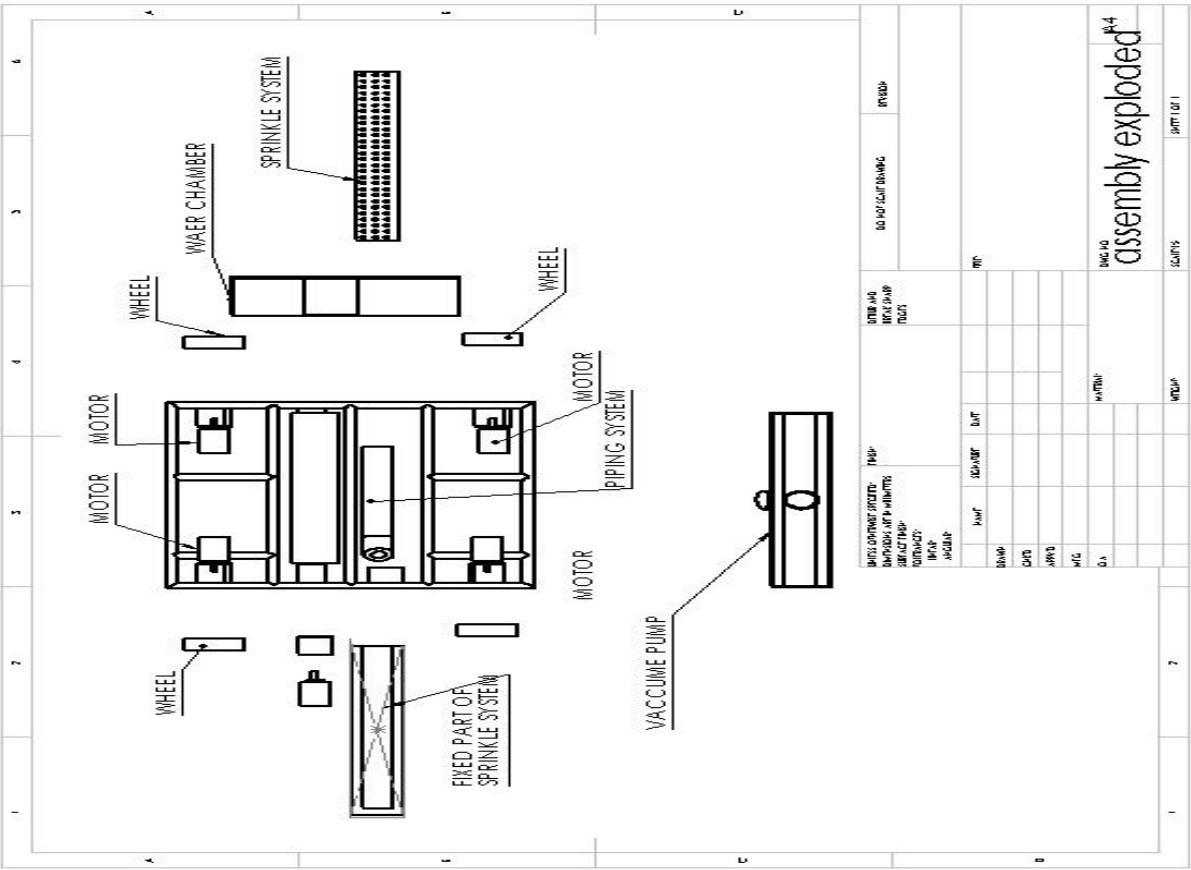


Figure 9 Isometric view of AFC



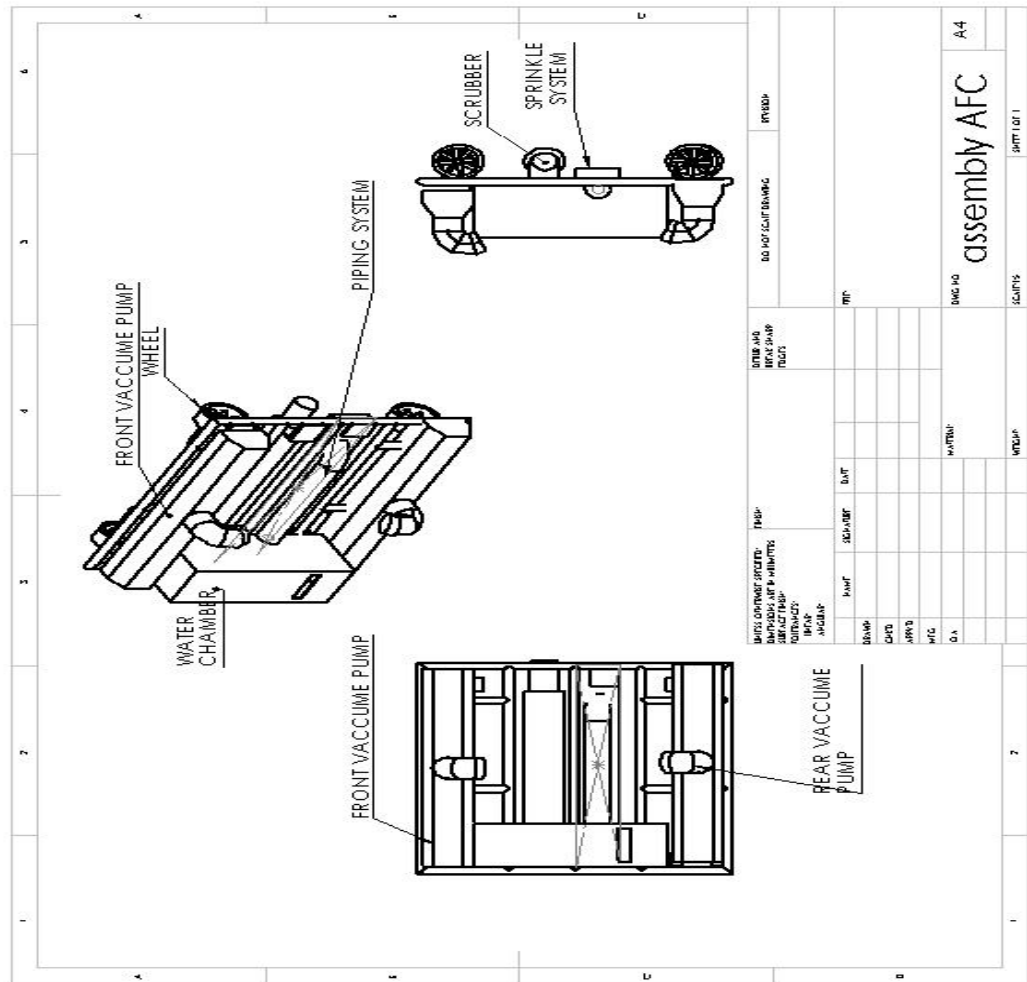


Figure10 2d view AFC

## ***CHAPTER-6***

### **ELECTRONICS PARTS USED:**

Different parts are directly used in the product. Such as vacuum pump, dc motor, sensor, micro-controller.

#### **6.1.VACUUM PUMP:**

It is a mechanical machinery that creates negative pressure which helps in sucking air. Vacuum pump exchanges the mechanical input power rotating shaft into pneumatic or hydraulic power by evacuating the air or liquid contained in a system. The pressure levels thus become lowered than the outside atmospheric pressure. The amount of power produced solely depends on the volume of air evacuated and the pressure difference being produced. In mechanical vacuum pumps the mechanism is so designed that air or liquid is sucked from closed area and being thrown to atmosphere. The major specialty of vacuum pumps are that the pressure here is below atmospheric pressure. The low pressure is achieved by moving a cycle of blades by a motor. the motion of air through the pump will be like the diagram shown.

#### **6.2. DC MOTOR:**

DC motor is an electrical machine that utilizes electric power resulting in mechanical power output. Normally the motor output is a rotational motion of the shaft. The input may be direct current supply or alternating supply. But in case of DC motor direct current is used. The mechanism of dc motor is like a bar wound with wire is placed in between 2 magnets having north and south pole. When it is provided with electric supply the wire becomes energized resulting in rotational motion which leads to rotational output.



*Figure 11 DC motor*

### 6.3. **SENSOR:**

It is a type of electronics component that uses ultrasonic transmitter and receiver pair to send and collect signals resulting in proper sense of obstacles.

The more the resonant frequency the lesser will be the wavelength of transmitted radiation and it will provide good surrounding condition. The more directional the sonic wave the more resolution in the measurement come. Sensitivity helps in decreasing signal to noise ratio.

Here we used two transducers of 40khz.as shown below



*Figure12 Sensor*

## 6.4. ARDUINO :-

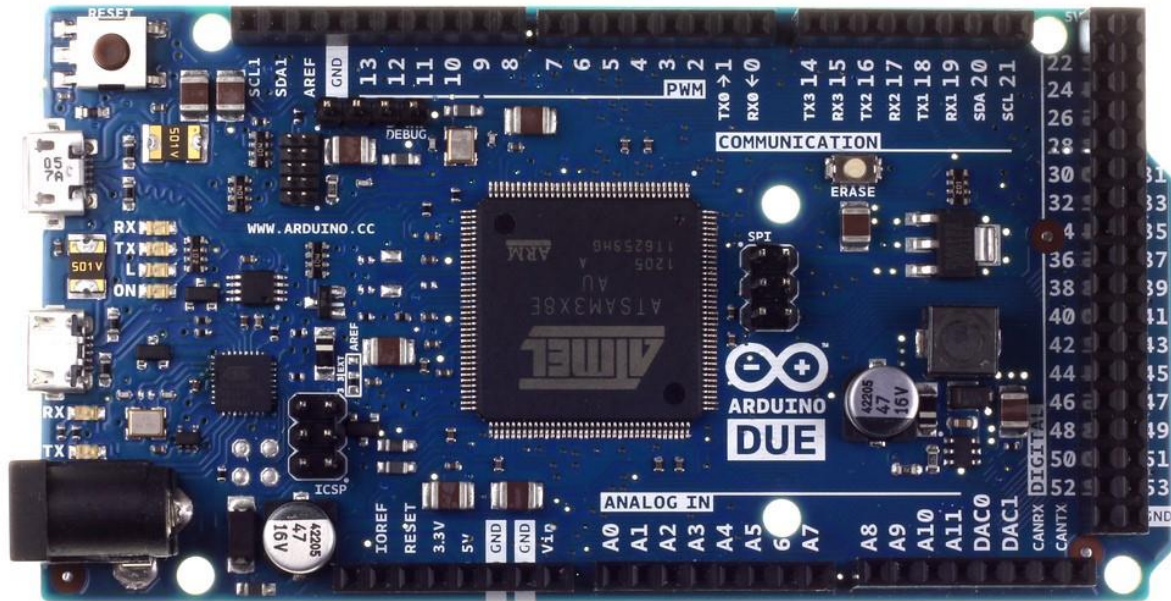


Figure 11 Arduino

Arduino plays a major role in automation .It acts as brain of the robot .It operates around the voltage of 3.3 volt. It uses atmega16 on its core which uses ARM processor .It has 54 digital I/O pins and 12 analog output pins. From 54 digital pins 12 are PWM (Pulse Width Modulation) pins.

2 DAC pins use 16 bit resolution and operates by the help of analogWrite() function. It has 2 USB ports. Such as:-

- Programming USB port
- Native USB Port

We can feed the program through programming usbport . Every program has 2 functions in its body. Such as :-

- loop() function
- setup() function

### 6.5. MOTOR DRIVER:-

We are using here L293D motor driver which has 16 pins 8 on each side. We can control maximum 2 motors connecting on each side.

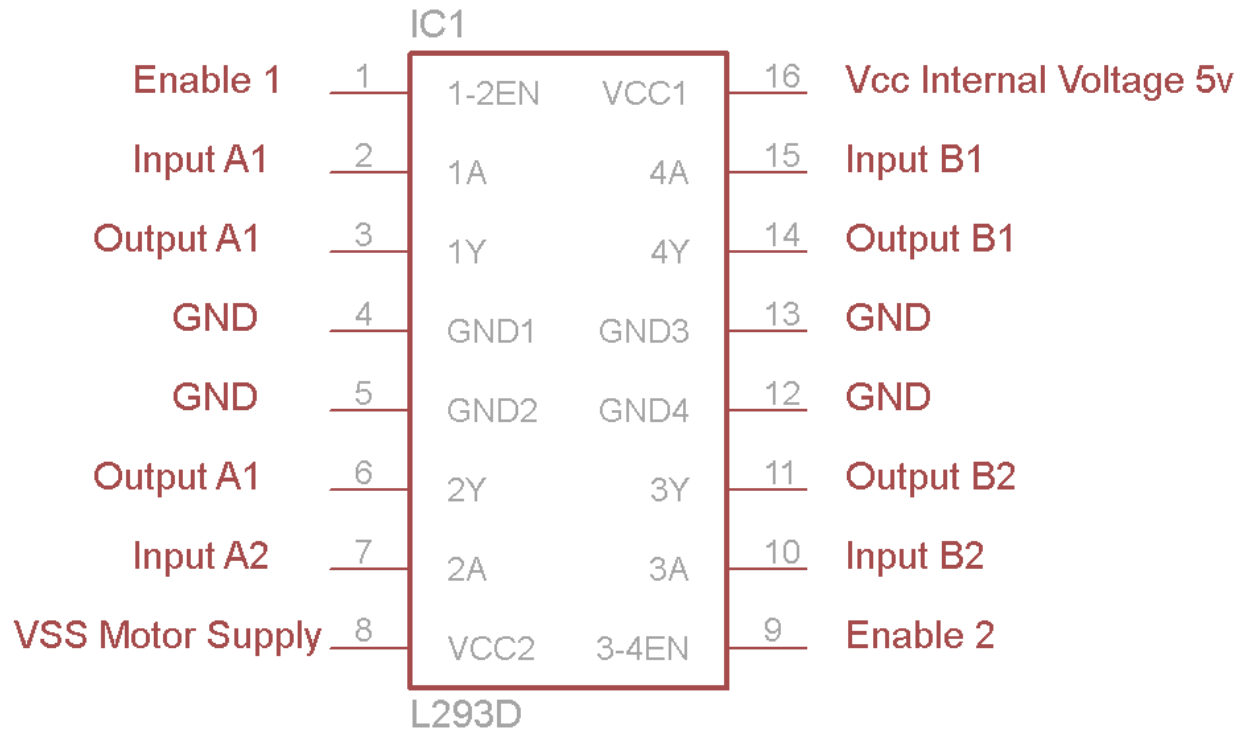


Figure 12 Motor Driver

On the left side two terminals OutputA1 and OutputA2 are connected to two terminals of motor and similarly on the right hand side OutputB1 and OutputB2 are connected to motor terminals. The inputs from the arduino board are connected through InputA1, InputA2, InputA3, and InputA4. Accordingly motor moves forward, backward, left side and right side.

If positive terminal of motor (i.e. pin3) is high and –ve terminal of motor (pin6) is low motor moves forward. If pin3 is low and pin4 is high then motor moves backward. If both the terminals are same then motor stops rotating.

First the obstacle is sensed and then the signal to arduino is sent and accordingly showing the distance of obstacle .Then arduino sends a signal to motor driver for respective turning motion of the bot.If the obstacle distance is 19 cm then bot starts rotating either sharp right or left.

If the right wheel moves backward and left wheel moves forward then bot takes sharp left movement. If the left wheel turns backward and right wheel turns forward then bot takes sharp right movement .

## ***CHAPTER-7***

### **Commercialization possibility:-**

Any product to be commercialized, the basic need is that it should have the need in the public. Automatic floor cleaner is an advancement over currently available cleaners. This product not only reduces man power, but also saves time. It is also cost effective product. If we consider the current market space for this machineirobot and scooba are playing major roles. They hold around 80% of the market. Their costs vary from RS 25000 to 35000.Also the algorithms used by them are not most effective. They are using algorithms which approximately provides 70% accuracy. They are not using any image processing algorithms to run their robot. But the robot designed by us is cost efficient which will cost around rs15000. Also we can use camera lens for small dust particle detection, so that it will give more efficient decision in governing the motion of the particle which ultimately save considerable amount of power and reduce the timing with better efficiency and sensitivity. This will act like a pheromone like in ant algorithm. In Ant algorithm when pheromone density of ants in particular direction is denser all other ants follow that direction. Similarly when the robot will find the particular dust size on floor on one side of it and there are none on other 3 sides, it will head towards dusty area. Time redundancy and power saving with low cost provides the best opportunity for marketing this consumer products. If we estimate the cost of manufacturing it cost rs8000 in our experimentation case. But for mass production it will be less than rs 5000. Including all other factors the market price will be well below rs1500. As we have utilized exchangeable scrubber, it can be used in any sort of floors. Basically it will be a boon for Indian house-hold.

## ***CHAPTER-8***

### **CONCLUSION:**

The product thus developed is fully operational and gives desired motion. It is being tested in a room which results in successful outcome. The scrubber design should be modified in future because the current design has few problems. Few of those are the motor is not detachable and the high rpm leads to vibration of the whole system. If these features will be modified, this will work well. In our case 2 vacuum pumps are used which leads to loss of power. This can be reduced by substituting these 2 pumps with one pump having 2 path ways. This will be the next development stages. This not only decreases cost but also increases reliability of the instrument. Overall the concept is very much helpful and there is scope of a lot of development in mechanical parts. The optimization will continue till achieving the best one. Overall the project is successful to its intent and will definitely change the era robotics and floor cleaning. In the automation part the algorithm are designed to give 90% efficiency which is too high in current scenario. The development can be made in the field of sensing. But this product has the capability to detect as well as move in the direction of dust and thus resulting in better cleaning of floors. As a whole this is a successful product developed that can be used in current Indian house-hold.

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